

# Table of Contents

---

<b>Chapter 1 Introducing Surfer .....</b>	<b>1</b>
Introduction to Surfer .....	1
New Features .....	2
Screen Layout and Window Types.....	4
Opening Windows .....	4
Object Manager .....	4
Toolbars.....	5
Scripter .....	5
Using Surfer .....	6
File Types .....	6
Gridding.....	7
Grid Utilities.....	7
Map Types .....	7
Reports.....	11
System Requirements .....	11
A Note about the User's Guide and Online Help .....	12
Installation Directions .....	12
Network Installation .....	13
Troubleshooting Installations .....	14
Updating Surfer .....	14
Uninstalling Surfer .....	14
Getting Help .....	15
Online Help .....	15
Context-Sensitive Help.....	15
Internet.....	15
Technical Support.....	15

## Table of Contents

---

<b>Chapter 2 Tutorial .....</b>	<b>17</b>
Tutorial Introduction .....	17
Tutorial Lessons .....	17
Understanding How to Use Surfer.....	18
Starting Surfer .....	18
Lesson 1 - Creating an XYZ Data File .....	19
Opening an Existing Data File.....	20
Creating a New Data File .....	21
Saving the Data File .....	22
Lesson 2 - Creating a Grid File .....	23
Lesson 3 - Creating a Contour Map.....	25
Opening the Map Properties .....	25
Changing Contour Levels .....	25
Changing Contour Line Properties .....	28
Adding Color Fill between Contour Lines .....	30
Add, Delete, and Move Contour Labels .....	32
Modifying an Axis.....	33
Saving a Map.....	36
Exporting 3D Contours.....	37
Lesson 4 - Creating a Wireframe.....	37
Creating a New Wireframe.....	37
Changing the Orientation of a Wireframe .....	38
Changing the Scaling of a Wireframe .....	39
Adding Color Zones to a Wireframe .....	40
Lesson 5 - Posting Data Points and Working with Overlays.....	42
Creating Post Maps.....	42
Changing the Post Map Properties .....	42
Overlaying Maps .....	44
Selecting an Overlay and Assigning an Object ID .....	45
Adding Labels to the Post Map .....	46

Lesson 6 - Introducing Surfaces .....	47
Creating a Surface .....	47
Adding an Overlay .....	47
Adding a Mesh .....	49
Changing Colors.....	50
<b>Chapter 3 Data Files and the Worksheet .....</b>	<b>53</b>
Introduction to Surfer Data and Worksheet Windows.....	53
Data Files.....	53
Worksheet.....	56
Working with Data .....	58
Entering Data into a Cell .....	58
Moving the Active Cell .....	58
Pasting Data.....	60
Opening Data Files .....	61
Data File Formats .....	61
Editing the Data Files in the Worksheet .....	62
Tips on Selecting Cells .....	62
Editing the Worksheet .....	63
Modifying the Worksheet and Data Files .....	64
Formatting the Data .....	67
Saving Data Files.....	81
Use Caution when Saving Excel Files! .....	81
File Names, Formats, and File Extensions .....	81
Saving ASCII Data Files .....	82
Page Setup .....	83
Page .....	83
Margins.....	84
Options .....	85

## Table of Contents

---

Creating a Data File with Digitize .....	86
Worksheet Technical Specifications.....	88
Worksheet Size and Memory Requirements .....	88
Numeric Limits.....	88
<b>Chapter 4 Creating Grid Files .....</b>	<b>89</b>
Introduction to Grid Files .....	89
A Gridding Example.....	90
Creating a Grid File .....	91
Data .....	92
Filter Data.....	92
Statistics.....	95
View Data.....	95
Grid Line Geometry .....	95
Grid Limits .....	97
Grid Density .....	97
Cross Validate .....	100
The Cross Validation Process.....	100
Using Cross Validation.....	101
The Cross Validation Dialog .....	101
Statistics Note.....	102
Cross Validation References .....	103
Grid Report.....	103
General Gridding Options .....	103
Search .....	103
Anisotropy .....	108
Breaklines and Faults .....	111
Gridding Methods.....	114
Inverse Distance to a Power .....	114
Kriging.....	117
Minimum Curvature .....	121
Modified Shepard's Method .....	125

Natural Neighbor .....	127
Nearest Neighbor.....	129
Polynomial Regression.....	131
Radial Basis Function.....	132
Triangulation with Linear Interpolation .....	135
Moving Average.....	137
Data Metrics .....	139
Local Polynomial.....	147
Choosing Gridding Methods .....	150
General Gridding Recommendations .....	150
Choosing Methods Based on the Number of XYZ Data Points .....	155
Exact and Smoothing Interpolators .....	156
Weighted Averaging.....	157
Producing a Grid File from a Regular Array of XYZ Data .....	158
Gridding a Function.....	159
Grid Files.....	159
Grid Files.....	160
GRD .....	160
USGS DEM.....	160
GTopo30.....	160
SDTS .....	160
DTED .....	161
<b>Chapter 5 Variograms .....</b>	<b>163</b>
Introduction to Variograms .....	163
Variogram Components.....	164
Kriging and Variograms .....	164
The Variogram Grid .....	165
The Variogram.....	168
Creating a Variogram .....	171

## Table of Contents

---

Editing Variogram Properties .....	171
New Variogram Properties .....	172
Data .....	172
General .....	173
Variogram Properties.....	175
Experimental .....	175
Model .....	180
AutoFit.....	188
Statistics.....	191
Plot .....	192
Default Linear Variogram .....	193
Exporting a Variogram .....	194
Using Variogram Results in Kriging .....	194
Suggested Reading .....	195
<b>Chapter 6 Contour Maps.....</b>	<b>197</b>
Introduction to Contour Maps .....	197
Drawing Contours .....	198
Contour Map Components.....	199
Creating a New Contour Map.....	200
Editing Contour Map Properties.....	200
Contour Map Properties .....	201
General .....	201
Levels .....	203
Contour Lines .....	207
Assigning Gradational Line Properties.....	207
Setting Line Properties on a Frequency Basis .....	209
Assigning Line Properties to Specific Contour Levels.....	210
Index Contours .....	211
Color Fill .....	212
Assigning Color Fill Based on a Fill Spectrum .....	213
Assigning Color Fill to Specific Contour Levels.....	214

Setting Fill Properties on a Frequency Basis .....	214
Creating a Filled Contour Map Containing Blanked Areas .....	216
Displaying a Filled Contour Map without Contour Lines .....	217
Color Scale Bar.....	218
Adding a Color Scale Bar .....	218
Editing a Color Scale Bar .....	218
Color Scale Bar Visibility.....	219
Removing a Color Scale Bar .....	219
Labels .....	220
Displaying Contour Labels at a Regular Interval .....	220
Assigning Labels to Specific Contour Levels.....	221
Setting Label Properties on a Frequency Basis .....	221
Label Spacing .....	223
Removing All Labels.....	224
Editing Label Positions.....	224
Hachures .....	226
Setting Hachures on a Regular Interval .....	226
Setting Hachures on Specific Levels .....	227
Setting Hachures on a Frequency Basis.....	227
Removing All Hachures .....	228
Smoothing Contours .....	229
Export Contours.....	230
<b>Chapter 7 Base Maps .....</b>	<b>231</b>
Introduction to Base Maps.....	231
Base Map File Types .....	232
Creating a Base Map .....	232
Editing Base Map Properties .....	233
Base Map Properties.....	233
Base Map.....	234
Changing Line, Fill, Font, or Symbol Properties in a Base Map.....	235
Assigning Coordinates to a Bitmap File.....	236

## Table of Contents

---

Placing Boundaries on Other Maps .....	237
Coordinates .....	237
Limits and Scale .....	237
Masking Portions of a Map .....	238
Digitize .....	239
Creating a Blanking File with the Digitize Command.....	240
<b>Chapter 8 Post Maps.....</b>	<b>241</b>
Introduction to Post Maps.....	241
Post Map and Classed Post Map Components.....	242
Data Files Used for Posting .....	243
XY Coordinates in the Data File .....	243
Z Values in the Data File .....	244
Data Labels in the Data File .....	244
Symbol Specifications in the Data File .....	244
Symbol Angle Values from the Data File.....	245
Creating a New Post Map or Classed Post Map .....	245
Editing Post Map or Classed Post Map Properties .....	247
Post Map and Classed Post Map Properties.....	247
General - Post Map.....	247
General - Classed Post Map.....	249
Labels .....	250
Classes .....	252
Updating the Data File.....	253
Classed Post Map Legends .....	254
Display Legend.....	254
Edit Legend Properties .....	254
Legend Properties Dialog .....	254
Scaled Symbols .....	256

---

<b>Chapter 9 Image Maps .....</b>	<b>259</b>
Introduction to Image Maps .....	259
USGS Elevation Files .....	259
Image Map Components.....	260
Creating a New Image Map.....	260
Editing Image Map Properties .....	261
Image Map Properties.....	261
General .....	261
Image Map Overlays .....	264
Color Scale Bars .....	264
Adding a Color Scale Bar.....	264
Color Scale Bar Visibility.....	264
Removing a Color Scale Bar .....	264
Editing a Color Scale Bar .....	265
<b>Chapter 10 Shaded Relief Maps .....</b>	<b>267</b>
Introduction to Shaded Relief Maps .....	267
Reflectance .....	267
Colors .....	267
USGS Elevation Files.....	268
Shaded Relief Map Components .....	268
Creating a New Shaded Relief Map .....	269
Editing Shaded Relief Map Properties .....	269
Shaded Relief Map Properties .....	269
General .....	269
Shaded Relief Map Overlays .....	272
Reference.....	272
<b>Chapter 11 Vector Maps.....</b>	<b>273</b>
Introduction to Vector Maps.....	273
1-Grid Vector Maps.....	273
2-Grid Vector Maps.....	273

## Table of Contents

---

Vector Map Components.....	274
Two-Grid Vector Map Data .....	275
Cartesian Data .....	275
Polar Data.....	277
Creating a New Vector Map.....	279
Editing Vector Map Properties .....	279
Vector Map Properties.....	280
Data - 1-Grid Vector Map .....	280
Data - 2-Grid Vector Map .....	281
Symbol.....	282
Scaling.....	284
Color Scale Bars.....	286
Adding a Color Scale Bar.....	286
Editing a Color Scale Bar .....	286
Color Scale Bar Visibility.....	287
Removing a Color Scale Bar .....	287
Clipping Symbols on Vector Maps.....	288
Clipping and Map Limits.....	288
Vector Length Legend.....	290
Editing the Vector Length Legend .....	290
Legend Properties Dialog .....	290
<b>Chapter 12 Wireframes .....</b>	<b>293</b>
Introduction to Wireframes .....	293
Wireframe Limits .....	293
Wireframe Grid Files.....	294
Wireframe Components.....	294
Creating a New Wireframe.....	295
Editing Wireframe Properties.....	295
Wireframe Properties.....	296
General .....	296
Z Levels.....	298

Color Zones .....	300
Specifying Lines .....	301
Line Properties.....	302
Line Property Precedence.....	303
Z Line Levels and Properties.....	303
Specifying Evenly Spaced Z Levels .....	304
Adding, Deleting, or Modifying Z Level Values.....	305
Assigning Z Level Properties Based on a Line Spectrum .....	305
Assigning Properties to Individual Z Levels .....	306
Color Zones .....	306
Specifying Color Zones .....	307
Assigning Color Zones based on a Line Spectrum.....	308
Assigning Line Properties to Specific Color Zones.....	308
Adding and Deleting Color Zones .....	309
Color Scale Bar.....	309
Adding a Color Scale Bar.....	309
Color Scale Bar Visibility.....	309
Removing a Color Scale Bar .....	309
Editing a Color Scale Bar .....	310
Wireframe Base .....	311
Smoothing a Wireframe.....	312
Blanking on a Wireframe .....	313
Wireframe Overlays .....	313
<b>Chapter 13 Surfaces.....</b>	<b>315</b>
Introduction to Surfaces.....	315
Surface Components.....	316
Creating a New Surface .....	316
Editing Surface Properties .....	317
Surface Properties.....	317
General .....	317
Mesh .....	319

## Table of Contents

---

Lighting .....	321
Overlays.....	323
Surface Base .....	325
Base Properties .....	325
Surface Overlays, Bases, and "Stitching" .....	327
Surface Memory Requirements .....	327
Surfaces and Zoom Levels .....	327
Surfaces and Printing.....	327
Color Scale Bars .....	328
Adding a Color Scale Bar .....	328
Color Scale Bar Visibility.....	328
Removing a Color Scale Bar .....	328
Editing a Color Scale Bar .....	329
<b>Chapter 14 Common Map Properties .....</b>	<b>331</b>
Introduction to Common Map Properties .....	331
Opening Map Properties.....	332
View .....	332
View and Overlays .....	332
Field of View .....	332
Rotation .....	332
Tilt .....	333
Projection.....	333
Setting the View .....	334
Using the Trackball Command.....	335
Scale .....	337
Setting the Scale .....	337
Using Scaling to Minimize Distortion on Latitude/Longitude Maps .....	338
Adding a Scale Bar to a Map.....	340
Limits .....	342
Limits and Wireframes .....	342
Limits and Axis Scaling .....	343

Limits and Map Scale .....	343
Limits and Post Maps .....	343
Limits and Base Maps .....	343
Limits, Scale, and Overlaying Maps.....	343
Setting Map Limits .....	344
Background .....	345
Masking with Background.....	346
<b>Chapter 15 Axes .....</b>	<b>347</b>
Introduction to Axes .....	347
Selecting an Axis.....	348
Displaying Axes .....	349
Axis Scaling .....	349
Axis Limits.....	350
Positioning Axes.....	351
Axis Titles .....	352
Axis Ticks and Tick Labels.....	353
Major Ticks .....	354
Major Tick Spacing .....	355
Minor Ticks .....	356
Tick Labels.....	357
Tick Label Format .....	359
Axis Tick and Line Properties.....	360
Grid Lines.....	360
<b>Chapter 16 Adding Color to Maps .....</b>	<b>363</b>
Introduction to Color Spectrums .....	363
Colors .....	363
Opening the Color Spectrum Dialog .....	364
The Color Spectrum Dialog.....	365
Reusing a Color Spectrum.....	367

## Table of Contents

---

Using Color Spectrums in Map Series.....	367
Know Your Data.....	368
Creating a Color Spectrum File .....	369
Using the Color Spectrum File in Other Maps .....	370
Level Files .....	370
Contour Maps .....	370
Wireframes .....	370
Creating Level Files .....	371
<b>Chapter 17 Positioning and Overlaying Maps .....</b>	<b>373</b>
Introduction to Positioning and Overlaying Maps.....	373
Moving Maps .....	374
Placing Several Maps in the Same Plot Window .....	374
Creating Several Maps in the Same Plot Window.....	374
Placing Several Completed Maps in the Same Plot Window .....	375
Aligning Several Maps on the Same Page.....	375
Overlaying Maps .....	376
Overlay Limits.....	377
Overlay Order .....	377
Wireframes and Hidden Lines .....	378
Adjacent Maps.....	378
Overlaying Maps .....	379
Editing Overlays.....	380
Hiding Overlays.....	380
Deleting Overlays.....	380
Stacking Maps .....	381
<b>Chapter 18 Grid Operations .....</b>	<b>383</b>
Introduction to Grid Operations .....	383
Spline Smoothing .....	383
Expanding a Grid.....	385
Recalculating a Grid .....	386

Grid Filtering .....	388
The Neighborhood.....	388
The Digital Filtering Dialog .....	389
Linear Convolution Filters.....	390
Nonlinear Filters.....	393
Edge of Grid .....	396
Blanked Nodes .....	398
Grid Filter References .....	398
Grid Mosaic .....	399
Grid Mosaic Dialog.....	399
Resample Methods .....	401
Joining Grids .....	402
Mosaic Tips .....	402
Blanking a Grid File .....	403
Blanking Inside or Outside a Polygon .....	404
Blanking Outside Multiple Polygons.....	405
Blanking Individual Grid Nodes.....	405
Grid Node Editor .....	406
The Options Menu.....	406
Using the Grid Node Editor.....	408
Grid Convert.....	409
Converting Grid File Formats.....	410
Grid Extract .....	411
The Extract Grid Dialog .....	412
Extracting Grids.....	412
Grid Transform.....	412
The Transform Dialog .....	412
Transforming a Grid File.....	415
Grid Math .....	416
Using the Grid Math Command .....	416
Using the Grid Math Command to Generate an Isopach Map.....	417
Using Grid Math to Eliminate Negative Values from a Grid File .....	418

## Table of Contents

---

Grid Calculus.....	418
Using Grid Calculus .....	421
Directional Derivatives.....	421
Terrain Modeling.....	427
Differential and Integral Operators.....	433
Fourier and Spectral Analysis.....	437
Grid Calculus References .....	442
<b>Chapter 19 Volumes, Areas, Cross Sections, and Residuals .....</b>	<b>443</b>
Introduction to Volumes, Areas, Cross Sections, and Residuals.....	443
Volumes and Areas.....	443
Volume Accuracy.....	444
The Grid Volume Report.....	445
Net Volume .....	446
Planar Area Calculations .....	448
Surface Area Calculations .....	449
Volume Reference .....	449
Calculating Volumes and Areas .....	449
Calculating the Volume between Two Surfaces.....	451
Calculating the Volume of a Lake .....	452
Volume of a Blanked Grid.....	453
Cross Sections .....	454
Cross Section Data File .....	454
Cross Section Blanking File .....	455
Blanking Files.....	455
Creating Cross Section Data.....	455
Plotting Cross Sections.....	456
Residuals .....	457
Calculating Residuals .....	458
Calculating the Value of the Surface at a Point .....	459

---

<b>Chapter 20 Importing and Exporting Maps and Graphics .....</b>	<b>461</b>
Introduction to Importing and Exporting .....	461
Importing Objects into Surfer .....	461
Import vs. Base Map.....	461
Import .....	461
Import Options .....	462
Paste Special.....	462
Exporting Objects .....	463
Export Options .....	463
Specifying File Type During Export .....	463
Bitmap Export .....	463
Coordinates and Scaling During Export .....	465
Spatial Formats .....	466
Suggestions on Selecting Export Formats .....	466
<b>Chapter 21 Creating, Selecting, and Editing Objects .....</b>	<b>467</b>
Introduction to Creating, Selecting, and Editing Objects .....	467
Creating Objects .....	467
Text.....	468
Polygon.....	469
PolyLine .....	470
Symbol.....	471
Rectangle .....	472
Rounded Rectangle.....	473
Ellipse.....	474
Selecting Objects .....	475
How to Select Objects .....	475
Bounding Boxes .....	477
Selection Handles .....	477
Deselecting Objects .....	478
Object Properties .....	478
Modeless Property Dialog .....	478

## Table of Contents

---

Setting the Properties for a Single Object.....	478
Setting the Properties of Multiple Selections .....	479
Setting Fill, Line, Symbol, and Text Properties .....	479
Label Properties.....	480
Custom Line, Fill, and Color .....	481
Setting Default Properties.....	481
Reshape .....	481
Arranging, Combining, Rotating, and Aligning Objects .....	482
Changing the Order in which Objects are Drawn.....	482
Changing the Order in which Maps are Drawn .....	482
Combining Objects.....	483
Rotating Objects .....	483
Aligning Objects.....	484
Object IDs.....	485
Assigning an ID to a Map.....	485
Deleting Objects .....	485
Moving and Resizing Objects with the Mouse.....	486
Using the Keyboard to Simulate Mouse Operations.....	487
Advanced Transformations.....	488
Transform Dialog .....	488
Transform References .....	489
Using the Object Manager.....	490
Opening and Closing the Object Manager.....	490
Changing the Object Manager Location.....	490
Object Visibility .....	490
Object Manager Tree.....	491
Selecting Objects .....	491
Opening Object Properties.....	491
Editing Object IDs.....	491
Arranging Objects .....	492
Deleting Objects .....	492

---

<b>Chapter 22 Automating Surfer .....</b>	<b>493</b>
Introduction to Automation .....	493
Surfer Automation Objects .....	494
The Surfer Object Model.....	494
Overview of Surfer Objects.....	499
A Brief Introduction to the Major Surfer Objects.....	502
Surfer Version 6 Object Model .....	508
Introducing Scriptor.....	508
Scripter Windows .....	509
Working with Scripts.....	511
Using Scriptor Help .....	511
Writing Scripts .....	512
The Scriptor BASIC Language.....	513
Code, Class, and Object Modules.....	524
Creating Dialog Boxes .....	528
Type Library References .....	532
The Object Browser.....	533
Compatibility with Visual BASIC.....	534
Suggested Reading .....	535
Running Scripts .....	535
Running Scripts from Scriptor .....	535
Running Scripts from the Command Line.....	536
Debugging Scripts .....	536
Viewing Errors .....	536
Run-Time Errors.....	537
Script Runs Incorrectly.....	537
Debug.Print.....	537
Stop or Pause .....	538
Viewing Variable Values.....	538
Changing Variable Values.....	538
Step.....	538
Breakpoint .....	539

## Table of Contents

---

Trace.....	540
Stack.....	540
Modules.....	540
Examples.....	540
Creating and Printing a Contour Map.....	540
Opening, Saving, and Closing Documents.....	542
Creating a Variogram.....	543
Overlaying Maps.....	545
Modifying Axes.....	546
<b>Chapter 23 Preferences.....</b>	<b>547</b>
Introduction to Preferences.....	547
General.....	547
Drawing.....	549
Selection Group.....	549
Default Attributes Group.....	550
Miscellaneous Options.....	550
Rulers and Grid.....	551
Dialog Defaults.....	552
Formats for Attribute Values.....	554
Colors.....	554
Line Properties.....	555
Fill Properties.....	555
Font Properties.....	556
Symbol Properties.....	557
Numeric Label Properties.....	558
Using Custom Setting Files.....	559
<b>Appendix A Mathematical Functions.....</b>	<b>561</b>
Introduction to Mathematical Functions.....	561
Formula Calculation.....	561
Mathematical Functions.....	562

Trigonometric Functions ..... 562

Bessel Functions ..... 562

Exponential Functions ..... 563

Miscellaneous Functions ..... 563

Statistical Functions of an Interval of Columns ..... 564

Boolean Expressions ..... 564

Transforming Data in the Worksheet ..... 564

Errors ..... 566

Examples ..... 567

**Appendix B Math Text Instructions..... 569**

Introduction to Math Text..... 569

Math Text Instruction Syntax ..... 569

Math Text Instructions ..... 570

    Instructions that Change Typefaces, Sizes, and Styles ..... 570

    Instructions that Change Text Color ..... 571

    Instructions that Change Text Position..... 571

    Instructions Used to Insert Special Characters or Date and Time ..... 572

Examples of Math Text Instructions..... 573

**Appendix C File Formats ..... 575**

Introduction to File Formats ..... 575

Grid File Formats ..... 575

    GS ASCII Grid File Format..... 575

    GS Binary Grid File Format ..... 578

    Surfer Grid and Surfer 7 Grid File Format ..... 579

Level File Format ..... 582

Color Spectrum File Format ..... 583

Import and Export File Formats ..... 585

    Golden Software Boundary Files ..... 586

    Golden Software Blanking Files..... 586

    Golden Software PlotCall Files ..... 587

# Table of Contents

---

Golden Software Interchange Files .....	588
USGS SDTS Topological Vector Profile Files.....	588
USGS Digital Line Graph Files.....	588
Bitmaps.....	588
Metafiles.....	589
Atlas Boundary Files .....	590
ESRI ArcInfo Export Format Files.....	592
ESRI Shapefiles.....	592
MapInfo Interchange Format Files .....	592
AutoCAD DXF Files.....	592
Data File Formats .....	593
ASCII Data File Formats.....	593
Excel Data Files.....	594
SYLK Files.....	594
Lotus Data Files.....	594
<b>Appendix D Line Styles, Fill Patterns, and Colors .....</b>	<b>595</b>
Introduction to Line Styles, Fill Patterns, and Colors.....	595
Line Styles.....	595
Fill Patterns.....	596
Colors .....	596
<b>Index .....</b>	<b>599</b>